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COLD STORAGE INVESTIGATIONS WITH WEALTHY APPLES

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SUMMARY

1. Wealthy apples grown in northern Iowa when properly ripened and carefully handled kept well in cold storage until late in February.

2. Apple-scald does not appear to be a factor in the storage of Wealthy apples on well ripened fruit.

3. Soft-scald was most abundant on immature fruit and especially on delayed stored immature fruit. Soft-scald was practically eliminated by immediate storage. This held true with fruit picked in either an immature or in a mature condition.

4, Oiled wraps practically controlled apple-scald on Wealthy and in some cases apparently reduced the amount of soft-scald, but the results with the latter cannot be taken as conclusive.

5. The percentage of Wealthy affected with rots resulting from skin injuries was 11 percent. Approximately seven percent of these rots resulted from mechanical injuries and four percent from growth cracks.

COLD STORAGE INVESTIGATIONS WITH WEALTHY APPLES

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By H. H. Plagge and T. J. Maney

Altho Wealthy is the most commonly grown apple in central and northern Iowa, this variety is not generally considered suitable for cold storage. Greene[1] reported storing Wealthy successfully as late as February 21 during one season; in another year he found it unsafe to hold Wealthy as late as December. He indicated that the keeping quality of Wealthy was affected by the locality where the fruit was grown. Wealthy from northern and central Iowa kept well until May when properly ripened and carefully handled.

Wealthy ripens late in August or early in September and has a very short harvest season. It changes from a green, immature condition to a well colored, fully ripe fruit in one week to ten days. Sometimes the fruit ripens prematurely and drops badly. As a large acreage of this variety is grown in the north central states, a great quantity of very desirable fruit is suddenly thrown upon the market during the harvest period. Frequently this causes a "glut," which results in heavy losses to growers and dealers. Under such market conditions, the fruit may not be picked, or may be allowed to spoil in the orchard.

Wealthy in its season is highly prized as a dessert and culinary apple, especially in northern apple regions. In this respect it is ranked by some next to Jonathan. After the Wealthy season passes, there is a period in the marketing of apples when there are no first class varieties available until the Jonathan season opens late in September. During this time, the few Wealthy which have been held in storage, bring excellent prices. Again, during years when there is a crop failure of Jonathan, stored Wealthy usually bring Jonathan prices.

Among growers, Wealthy has a bad reputation as a storage variety. Under certain conditions, the fruit is severely affected with apple-scald, soft-scald, shriveling and rots. It is generally assumed that Wealthy is inherently susceptible to these disorders. However, there is a question whether these troubles may not be due to incorrect methods of picking, handling and storing.

On account of the several considerations enumerated above, it was considered advisable to carry on further storage experiments with this variety during the season of 1923-1924, the results of which are given in the present report.

[1]Greene, Laurenz. (1913.) Cold Storage for Iowa Grown Apples. Bul. Iowa Agr. Exp. Sta. 144, p. 357-378.

OUTLINE OF MATURITY EXPERIMENTS ON WEALTHY

The apples used in this experiment came from the orchard of the Iowa Apple Growers, Inc., at Charles City, Iowa. They were packed in standard commercial bushel baskets and were subjected to a total of 60 different conditions, including combinations of (a) maturity at time of picking, (b) delay in placing in storage, (c) percentage of total area of each apple cov-

TABLE I. OUTLINE SHOWING CONDITIONS INCLUDED IN STORAGE EXPERIMENTS.

Date of picking	Delay in placing in storage		Percentage of color	Wrap	Storage conditions after Nov. 1*
	No. days delayed	Date cold stored			
Aug. 27	1	Aug. 28	25	Wrapped	Warm room Cool cellar
				Unwrapped	Warm room Cool cellar
				Wrapped Unwrapped	Cold storage Cold storage
			50	Wrapped	Warm room Cool cellar
				Unwrapped	Warm room Cool cellar
				Wrapped Unwrapped	Cold storage Cold storage
	7	Sept. 3	25	Wrapped Unwrapped	Cold storage Cold storage
			50	Wrapped Unwrapped	Cold storage Cold storage
	14	Sept. 10	25	Wrapped Unwrapped	Cold storage Cold storage
			50	Wrapped	Cold storage Cold storage
Sept. 4	1	Sept. 5	50 to 75	Wrapped	Warm room Cool cellar
				Unwrapped	Warm room Cool cellar
				Wrapped Unwrapped	Cold storage Cold storage
			75 to 100	Wrapped	Warm room Cool cellar
				Unwrapped	Warm room Cool cellar
				Wrapped Unwrapped	Cold storage Cold storage

TABLE I (Continued). OUTLINE SHOWING CONDITIONS INCLUDED IN STORAGE EXPERIMENTS.

Date of picking	Delay in placing in storage		Percentage of color	Wrap	Storage conditions after Nov. 1*
	No. days delayed	Date cold stored			
Sept. 4	7	Sept. 11	50 to 75	Wrapped	Cold storage
				Unwrapped	Cold storage
			75 to 100	Wrapped	Cold storage
				Unwrapped	Cold storage
	14	Sept. 18	50 to 75	Wrapped	Cold storage
				Unwrapped	Cold storage
			75 to 100	Wrapped	Cold storage
				Unwrapped	Cold storage
Sept. 11	1	Sept. 12	60 to 85	Wrapped	Warm room
					Cool cellar
				Unwrapped	Warm room
					Cool cellar
				Wrapped	Cold storage
				Unwrapped	Cold storage
			85 to 100	Wrapped	Warm room
					Cool cellar
				Unwrapped	Warm room
					Cool cellar
				Wrapped	Cold storage
				Unwrapped	Cold storage
	7	Sept. 18	60 to 85	Wrapped	Cold storage
				Unwrapped	Cold storage
			85 to 100	Wrapped	Cold storage
				Unwrapped	Cold storage
	14		60 to 85	Wrapped	Cold storage
				Unwrapped	Cold storage
			85 to 100	Wrapped	Cold storage
				Unwrapped	Cold storage

*All apples remained in cold storage until Nov. 1, when first inspection was made. Subsequent storage conditions on different lots are indicated in table.

ered with red color, (d) use of oiled paper wraps, (e) comparison of keeping qualities of certain lots of apples under continuous cold storage conditions with others which were held in cold storage until Nov. 1, and then removed and subjected to warm room and cool cellar conditions. Table I shows graphically the sets of conditions to which the samples under experiment were subjected.

The picking dates were chosen to secure samples before, at,

and after the normal picking season for the year. The apples were stored in the Pomology Section cold storage at 32° F., with a relative humidity of 80 to 85 percent. They were sent from Charles City by express, at weekly intervals, one day being consumed enroute. The samples whose storage was delayed after picking were held in a cellar at Charles City at a temperature of 55° to 60° F.

On August 27 the fruit still lacked color, and as events later proved, most of it was immature. By September 4 the apples

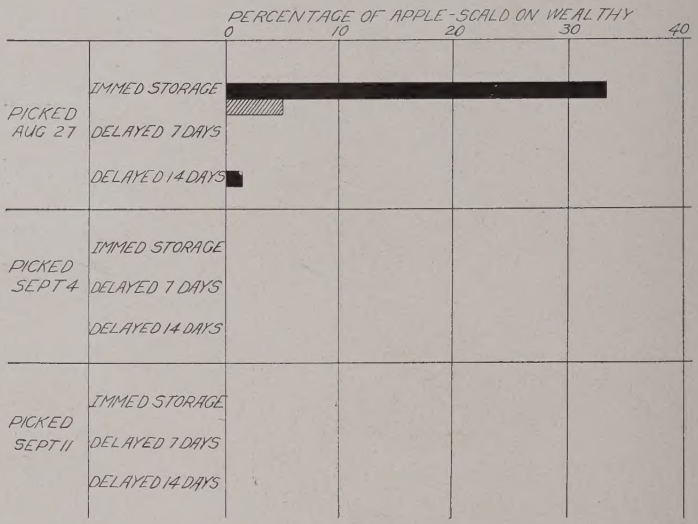

Fig. 1. Percentage of apple scald on Wealthy apples on February 22. The amount of scald on the unwrapped fruit is shown by the solid bar and the amount of scald on the fruit in oiled wraps by the shaded bar.

were well colored and it is believed this date was as nearly the ideal date for harvesting Wealthy as could have been selected for the season and locality. On September 11 practically all the fruit was as fully colored as it ever would be and many apples were dropping from over maturity.

APPLE-SCALD ON WEALTHY

The apples were inspected on November 1 for apple-scald and other storage disorders. All of the fruit was found to be sound at this time.

On February 22, the fruit was again examined and at this time various disorders were found. The amount of apple-scald

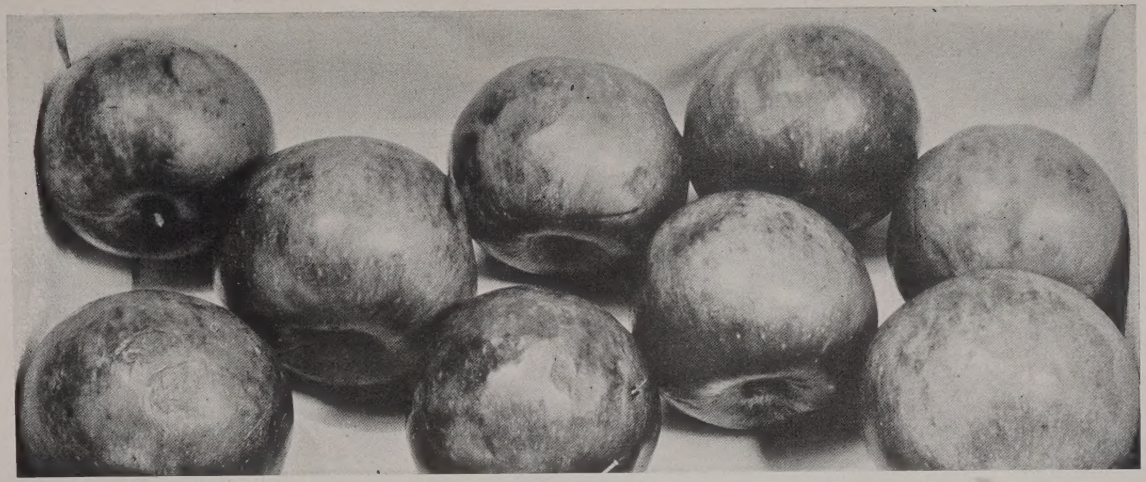

Fig. 2. Apple scald on Wealthy apples. These apples were picked in an immature condition and stored immediately.

present on this date for the various treatments is shown in fig. 1.

Apple-scald occurred only on the apples picked August 27 when all were immature and practically all was on the fruit which was stored immediately. Apples whose storage was delayed one week showed no apple-scald, tho a very slight amount of scald occurred on fruit whose storage was delayed for two weeks. It may be concluded, therefore, that apple-scald on Wealthy apples is directly associated with immaturity at picking time and its prevention is accomplished by picking when the apples reach the correct degree of maturity.

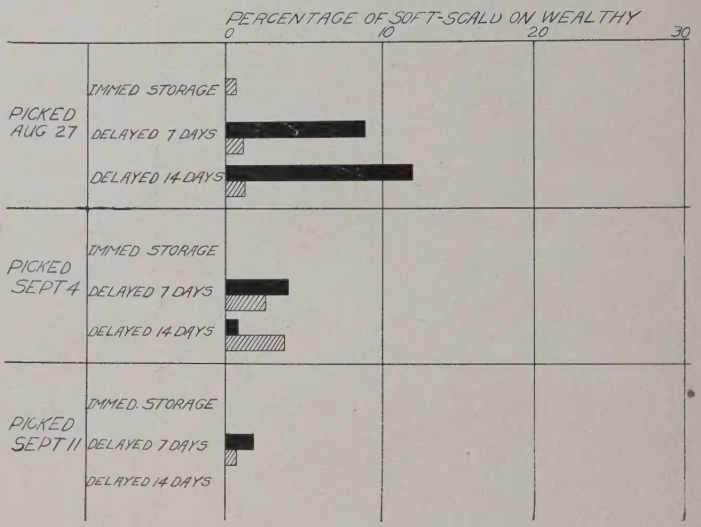

Fig. 3. Effect of the maturity of the fruit upon the development of soft scald on Wealthy apples in cold storage. The percentage of soft scald on the unwrapped fruit is indicated by the solid bars and that on oiled wrapped fruit by the shaded bars. The fruit was examined on February 22.

No scald occurred on fruit wrapped in oiled wraps except in the case of fruit which was picked in an immature state and stored immediately, where the amount of scald was only five percent. As the corresponding sample under the same treatment without oiled wraps showed 33.5 percent of scald, it may be concluded that oiled wraps were very effective in preventing this trouble.

Part of the sound fruit of each of the two baskets picked August 27 and stored immediately, was placed at a temperature of 70° F. for five days. Of the apples which had not been

Fig. 4. Soft scald on the Wealthy apple. Note that while the calyx end is the more susceptible to the disease, the region just immediately adjoining the calyx is not affected.

Fig. 5. Wealthy removed from cold storage in December. Note freedom from shriveling.

wrapped in oiled wraps, 90 percent scalded during the five day period. None of the fruit previously wrapped in oiled wraps showed scald at the end of the period. Fig. 2 shows the type of apple-scald which occurs on immature Wealthy.

SOFT-SCALD ON WEALTHY

Soft-scald may be a factor in the storage of Wealthy under cold storage conditions. Fig. 3 shows the amount of soft-scald developing on wealthy for various conditions of picking and storage. From this figure it will be seen that early picking with delayed storage induces soft-scald. Immediate storage

Fig. 6. Wealthy removed from cold storage on November 1; in cellar storage until December 10. Note the amount of shriveling.

has given the least amount of soft-scald on fruit for all three pickings. These results are similar to those reported by the writers in a previous publication[2] on the soft-scald of Jonathan.

While there was less soft-scald when the apples were wrapped in oiled wraps, in some cases there was more soft-scald on wrapped apples than on unwrapped. It is probably unsafe to draw conclusions for Wealthy on this point as the observation is based on the results of one season only. In the investigations with Jonathan,[2] it was found that oiled wraps do not reduce the the amount of soft-scald.

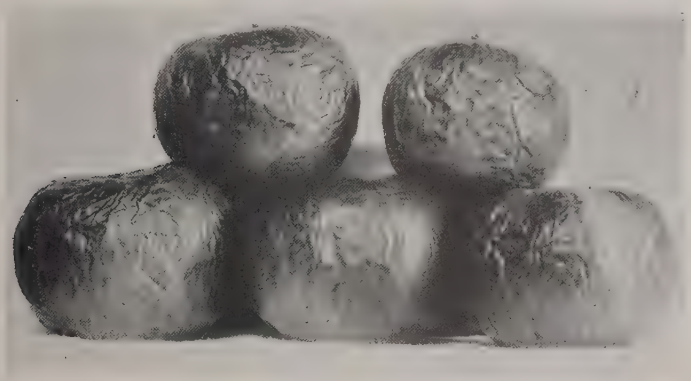

Fig. 7. Wealthy removed from cold storage November 1; under retail store condition until December 10. Note excessive amount of shriveling.

BEHAVIOR OF WEALTHY AFTER REMOVAL FROM COLD STORAGE

On November 1 the six baskets of fruit, stored to determine the keeping quality of Wealthy at warmer temperatures after removal from storage, were removed from cold storage. Three of these baskets had been wrapped in oiled wraps and three had been unwrapped. One wrapped and one unwrapped basket had been picked on each of the three picking dates and all had been stored immediately. One-half of the fruit of each basket was placed in a room at a temperature of 70° F. with a relative humidity ranging between 15 and 40 percent. These conditions are comparable to those found in the average retail store. The other half of the fruit of each basket was placed in ordinary cellar storage where the temperature was approximately 50° F. and the relative humidity 55 percent.

[2]Plagge, H. H., and Maney, T. J. (1924.) Apple Storage Investigations, Fourth Progress Report, I—Jonathan-Spot and Soft-Scald; II—Apple-Scald and Internal Breakdown. Bul. Iowa Agr. Exp. Sta. 222.

Fig. 8. Mechanical injuries due to basket cuts and to carelessness in handling. Apple rots have followed these injuries.

Fig. 9. Skin injuries due to growth cracks. This type of injury is often found on Wealthy after a period of dry weather. Apple rots easily gain entrance within the apple thru these injuries.

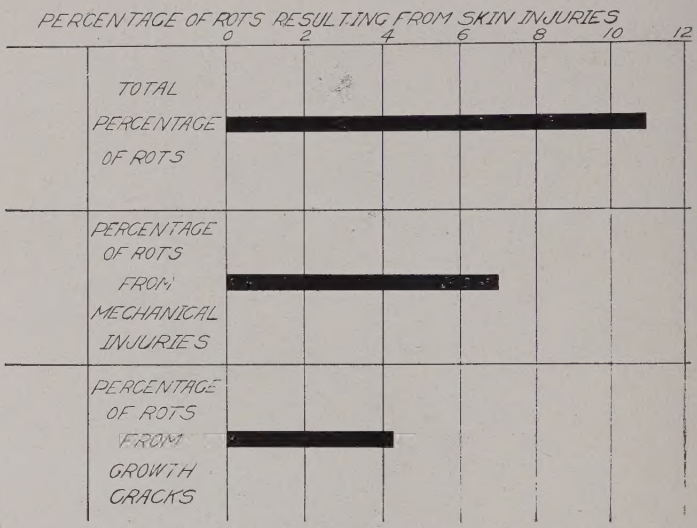

Fig. 10. Average percentage of apple rots on all apples in experiment resulting from various skin injuries. Note that a greater proportion of the rots from injuries resulted from mechanical injuries which can be largely prevented.

After 40 days, it was observed that no storage troubles such as apple-scald or soft-scald had occurred on any of the fruit removed from cold storage. However, the fruit at this time was practically unsalable because of the severe shriveling brought about by low humidity conditions.

The time limit for commercial handling of this variety out of storage was in no case longer than 10 days under retail store conditions and 15 days under cellar storage. There was not much difference in the keeping quality of the lots of fruit as affected by time of picking and time of storing. Oiled wraps slightly reduced the amount of shriveling. The poorly colored fruit shriveled more than the well colored fruit. There was about as much difference in the amount of shriveling between the poorly colored and well colored fruit as there was between the oiled wrapped and unwrapped fruit. Figures 5, 6 and 7 show the relative amount of shriveling on Wealthy under cold storage, cellar storage and retail store conditions, respectively.

KEEPING QUALITY OF WEALTHY AS AFFECTED BY SKIN INJURIES

In examing the fruit it was observed that in practically all cases the apple rots present were located where the skin had

[2]Plagge, H. H., and Maney, T. J., (1924.) Apple Storage Investigations, Fourth Progress Report, I—Jonathan-Spot and Soft-Scald; II—Apple-Scald and Internal Breakdown. Bul. Iowa Agr. Exp. Sta. 222.

been injured. These skin injuries were of two types, mechanical injuries and growth cracks, shown in figs. 8 and 9, respectively.

The mechanical injuries commonly found on apples in baskets may be due to the basket itself, which may have protruding wire handles, staples or staves, or they may result from stem punctures and injuries occurring during picking, grading and sorting.

The skin injuries due to growth cracks can usually be associated with periods of dry weather or drouth conditions. Wealthy is peculiarly susceptible to growth cracks, which occur in more or less eccentric bands around the stem of the apple. The number of cracks on an apple varies considerably. Small as well as large apples are subject to this injury. The season of 1923 was favorable for its development, as a long period of unusually dry weather was followed by heavy rains just before harvest time. This probably accounts for the large number of growth cracks which occurred.

Fig. 10 shows the total percentage of apple rots resulting from skin injuries and the proportional percentages of rots resulting from mechanical injuries and growth cracks. Approximately 11 percent of the apples were affected with rots because of skin injuries. The percentages of apple rots resulting from mechanical injuries and growth cracks were approximately seven percent and four percent, respectively.

DISCUSSION

The foregoing data need little discussion. The experiments indicate that Wealthy, grown in the northern half of Iowa, when properly ripened and carefully handled, may be kept successfully in cold storage until late in February. The data show that this variety keeps better in cold storage when stored immediately than when stored after a delay. Apple-scald was found to be a factor only on fruit picked in an immature condition. Soft-scald was abundant on delayed stored fruit picked in an immature condition.

It is desirable and practical to make two or three pickings of Wealthy, as the fruit ripens unevenly on the tree. Since apple-scald does not appear to be a factor on well ripened Wealthy, the advisability of using oiled wraps as a scald preventive is somewhat questionable. However, a more desirable pack with less bruising and shriveling resulted with the fruit which was wrapped. As a protection for the fruit, it may even be advisable to wrap the fruit when packing in bushel baskets. As Wealthy is a thin skinned apple, emphasis should be placed

upon careful handling when it is to be held in storage. When grading, special attention should be given to the elimination of skin injuries, including growth cracks.

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